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(54) **Microporous separator for storage batteries and relative process and apparatus for continuous manufacture.**

(57) The separator comprises a plurality of longitudinal channels and ribs. The ribs are hollow and closely spaced apart with center distance less than 12 mm. Both the channels (C_1, C_2, ...) and most of the ribs (N_3, N_4, ...) have longitudinal hollow projections respectively protruding on the two opposite sides of the separator. The ribs and projections contribute to define the bearing planes or faces of the separator, improve the characteristics thereof of longitudinal and transverse rigidity and assure a constant spacing between the plates when assembled therebetween owing to the increased number of contact points or locations therewith.

The distribution of projections on a separator is sufficiently different from that of a plurality of separators intended to be superimposed or stacked to one another, no projection of one of such separators can nest in a cavity of another separator an the extraction of any separator from the pack can be readily carried out (Figure 1).

In a continuous production process, the separators are obtained from a strip of material which in case is preheated, then drawn by means of two rollers and finally cut to measure. The strip may be fed from a roll or from a strip forming system, and particularly from a sintering furnace when using thermoplastic powders.

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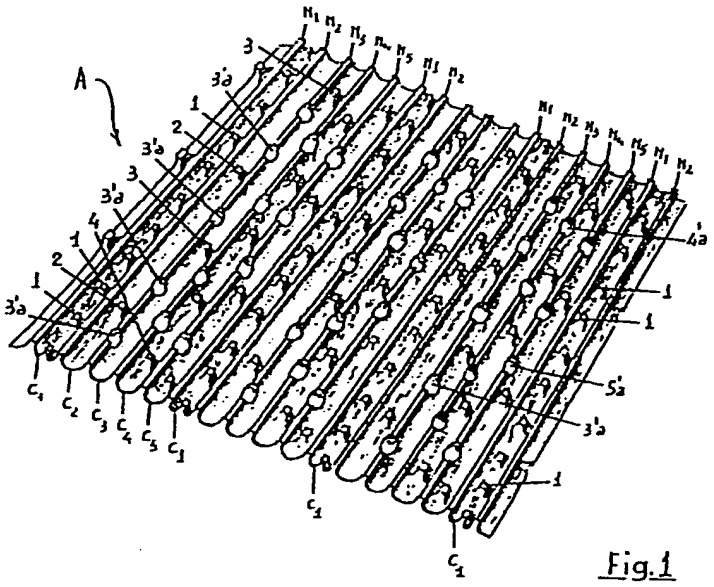

Fig.1

"A MICROPOROUS SEPARATOR FOR STORAGE BATTERIES AND RELATIVE PROCESS AND APPARATUS FOR CONTINUOUS MANUFACTURE"

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This invention relates to microporous separators for storage batteries, particularly starter batteries, of the type comprising a plurality of longitudinal channels and ribs.

The invention also relates to the process and apparatus for continous manufacture of such separators. Different types of separators are known having continuous ribs for storage batteries which differ from one another for the type of material used and shape or design. The continuous ribs perform the function of defining longitudinal channels therebetween the bleed or vent of gases being developed in the battery, in addition of course to assuring the required spacing between the plates of different polarity.

As to the material used, the separators may be of thermoplastic material, being in such a case obtained by sintering of thermoplastic powders. Prior to sintering and while sliding on a conveyor belt, the powder mass is shaped by means of a comb or reed, so that at the outlet of the sintering furnace the separator is formed of a flat portion or flash and full ribs. Therefore, the total thickness of the separator comprises the sum of the flash thickness and rib height.

Owing to the full ribs, these separators require the use of some amount of material and accordingly are quite expensive and heavy.

In addition, still because of the full ribs, they exhibit some electric resistance to the benefit of the width of the flat portion, while allowing the passage of the required ionic flow. Normally, the spacing between the ribs in the separators is in the range of 14 to 20 mm.

On the other hand, with a reduced number of ribs, the separator does not exhibit a sufficient longitudinal rigidity with a resulting reduction in its deflection resistance, the latter being instead a feature required when assembling of the separators with plates is effected by means of automatic machines, such as those commonly referred to as "stacking machines".

In the use of these machines, during the formation of the plate packs, the separators are assembled in packs which rest on two brackets laterally arranged and are individually extracted from below the packs by means of a blade of the machine.

Thus, it clearly appears that to provide an easy extraction of the separators as the same are laid on the brackets, it is necessary that in addition to not jamming with the overlying separator they should have a sufficient deflection resistance, so as to remain at erected attitude on the bracket plane, irrespective of the overlying load.

Moreover, with the reduced number of ribs, bearing with the plates is reduced to only the contact lines defined by the separator ribs, with the result that during the battery operation, particularly at the intensities of high overcharge, the required spacing between the plates is not always assured due to the insufficient resistance to deformation of the flat portion or flash.

It is also evident that as the spacing between the ribs increases, there is a reduction in the transverse rigidity of the separator, which is therefore liable to breakage during assembling operations prior to arrangement in the battery.

It is another disadvantage in the thermoplastic separators of the prior art that the ribs act as rigid fillets or strips, so that in contact with the active material of the plates a scaling off thereof is caused upon mechanical vibrations generated by the vehicle on which the battery is mounted. Accordingly, the useful life of the battery is reduced.

Many of the above mentioned drawbacks also occur in other types of ribbed separators, for example in cellulose separators hardened with

various resins and ribbed by longitudinal corrugations.

In addition, these separators have a low transverse strength when produced in thin flashes owing to the nature of the material and are therefore readily subjected to breakages as a result of impacts. Moreover, cellulose is liable to become deteriorated in contact with acids. Finally, the process of manufacture for the separators is complicated and costly.

Similar remarks are also valid for cellulose separators ribbed with longitudinally extruded thermoplastic materials.

It is the object of the present invention to provide a microporous separator fitted with longitudinal channels and ribs that will eliminate the disadvantages of the prior art separators and particularly which is very economical and light, having a good transverse and longitudinal rigidity, a good electrical conductivity and assures a high number of contact points or locations with the plates, in addition to being particularly adapted for use of automatic machines during the formation of plate packs.

According to the invention, the above objects are achieved by a separator provided with longitudinal channels and ribs, characterized in that said ribs are hollow and in close spacing relationship over those of conventional separators and have substantially the same thickness as that of the flat portion or flash defining the channel, and that both the channels and ribs, or most of the latter, respectively have on the two opposite sides of the separators, hollow longitudinal projections contributing to define the two bearing planes or faces of the separator, and the distribution of which in a plurality of separators intended for superimposition varies to sufficient degree from one to another separator, so that in a pack of separators no projection of a separator is allowed to nest in the cavity of the other separator, and extraction of any separator can be easily effected according to the bearing plane or face.

The separator is further characterized in that the spacing between the ribs is less than 12 mm, preferably in the range of

between 6 and 12 mm, and that the longitudinal projections of the channels protrude from the side of the ribs, while the longitudinal projections of the ribs generated by depressions protrude from the opposite side, and that the projections of one or some channels distributed transversely of the separator follow one another at close spacing, while the projections of the remaining channels and ribs discontinued by the depressions follow one another at irregular and larger spacing than that of the close spaced apart projections, and that the projections at irregular spacing of the channels and discontinued ribs between two channels with projections closely spaced apart or juxtaposed to one or such channels shifted transversely of one another and longitudinally with respect to the projections of the corresponding channels and discontinued ribs of a plurality of separators intended to be superimposed to one another.

Further details and features of the separator will become apparent from the following description given by mere way of example with reference to a preferred embodiment of the invention shown in the accompanying drawings, in which:

Fig. 1 is a perspective view showing a microporous separator according to the invention;

Fig. 2 is a view showing the separator of Fig. 1, but from the opposite side;

Fig. 3 is a perspective view of two separators, forming part of a plurality of separators according to the invention, intended to be superimposed to one another;

Fig. 4 is an enlarged perspective view showing a plurality of separators of the type shown in Fig. 3 as superimposed to one another;

Fig. 5 is a sectional view of the superimposed separators of Fig. 4;

Fig. 6 is a schematic view of a system for continuous manufacture of separators according to the invention; and

Fig. 7 is a view showing a length of separator strip at the outlet of the system of Fig. 6, as shaped, but prior to cut to the separator

size.

Referring to Figs. 1 and 2, a separator A comprises a plurality of lonfitudinal ribs N_1, N_2, N_3, N_4, ... N_5 and a plurality of longitudinal channels C_1, C_2, C_3, C_4, ... C_5 defined by said ribs.

According to a first aspect of the invention the ribs, as more clearly shown in Figs. 4 and 5, are hollow and substantially have the same thickness as the separator flash, which flash may be flat or curved depending on its thickness and spacing of the ribs.

Additionally, such ribs are at very close spacing from one another with a constant pitch below 12 mm, preferably in the range of between 6 and 12 mm, depending on practical requirements. Thus, satisfactory results have been found with a separator 153 mm wide, having 18 ribs with a pitch of 8.5 mm.

According to a further important aspect of the invention, both the channels and ribs, or most of the latter, respectively have on the two opposite sides of the separator hollow longitudinal projections defining with the flat portion the two bearing planes or faces of the separator, as better explained in the following.

The longitudinal projections of the channels, such as the projections 2, 3 of channels C_2, C_3 protrude from the rib side, while the longitudinal projections of the ribs, such as projections 3a, 4a, 5a of ribs N_3, N_4, N_5 protrude from the opposite side and are generated by corresponding depressions in the ribs.

Thus, the ribs provided with depressions are discontinued.

Some channels denoted at C_1, defined by continuous ribs N_1, N_2 and which are distributed in a limited number transversely of the separator, have longitudinal projections 1 also hollow and protruding from the rib side.

Such projections 1 follow one another at close spacing and with a constant pitch equal to or slightly larger than the width of channels 1 in which they are formed.

Conversely, the projections in the channels and ribs between two channels C_1, such as projections 2, 3a, 3, 4a longitudinally follow one

another at irregular and larger spacing than projections 1 of C_1.

Referring to the drawings, such projections are those formed in channels C_2 to C_5 and in the discontinued ribs N_3 to N_5.

Moreover, these irregularly spaced apart projections are longitudinally formed at a different spacing with respect to the projections of close channels or discontinued ribs, so that in a same separator the irregularly spaced apart projections, such as 2, 3a, 3, 4a between two channels C_1, are transversely shifted from one another. The reason of this distribution for the projections will be explained hereinafter.

With hollow ribs and at a same total thickness of the separator, less is the required amount of material and accordingly the separators are less costly and lighter over the separators of the prior art with full ribs.

Additionally, hollow ribs, having the same thin thickness as the separator flash, contribute to a much less degree to the passage of electronic current. It is a further advantage that the rib thickening would improve the longitudinal rigidity of the separators and thus the deflection strength thereof, whereby the use of automatic machines in the formation of plate packs is particularly adapted thereto. The longitudinal projections 1, 2, 3a, 3 ... along with the flash and the continuous or discontinued ribs, all of which terminating in a flat surface, define as above mentioned the two bearing surfaces of the separator with the plates, which surfaces are larger than those of the conventional separators, higher being the number of contact points or locations as provided by means of the thickened ribs and longitudinal projections.

Thus, assured is a good conservation of the active material on the plates also in view that, owing to the plurality of ribs, the separator is no longer a rigid element between the plates, but acts as a flexible bearing.

Moreover, the plurality of supporting locations assure a constant interspacing between the plates under all of the battery operating conditions.

Finally, the hollow ribs and projections increase the electrolyte volume available at the plates in addition to increasing the electronic resistance between the plates, because of the longer path that the current should in case travel to pass from one to another plate.

The longitudinal projections, such as 3a, 4a, 5a ... generated by the depressions on ribs N_3 to N_5 ... provide a lateral connection between the channels and accordingly provide the separator with characteristics of transverse rigidity. Thus, breakages of the separator are unlikely to occur during the assembling operations in the battery.

The hollows or depressions on the discontinued ribs, as well as the hollows on the channels generating the projections 1, 2, 3, 3a, 4a ... are denoted on the drawings by the same references as the projections, but followed by an apex (').

The rib projections as well as the projections 3a, 4a ... are of convex shape, while the depressions 3a', 4a' are concave. With the depth thereof, the latter reach the flash level, so as to put the two adjoining channels in communication, thus allowing an improved circulation of the electrolyte between the channels.

The projections 1, 2, 3 ... formed in the channels C_1, C_2, C_3 ... are instead of tapered shape from the base to the end. Projections of truncated pyramid have shown to be particularly suitable, as not hindering the passage of liquid or mud fall, etc.

Of course, the pyramid base should engage only a portion of the channel width, so that the liquid will continue to flow through the channel lapping on the two sides of the pyramid.

Where allowed by the channel width, instead of one pyramid, two juxtaposed pyramids could be provided, so that the longitudinal passages for the liquid would become three.

For a good extraction of the separators from a pack, it was found advantageous to maintain the height of the rib projections at the level of the plane corresponding of the flash or just below and make the end of the channel projections slightly protrude from the rib plane.

Fig. 3 shows two separators A and B comprising two elements of a plurality of separators to be stacked.

Separator A is again separator 1 of Fig. 1, while separator B is completely identical to separator A, with the only difference that the longitudinal projections of the channels and discontinued ribs between two channels C_1, such as projections 2b, 3b (3'b), follow one another at a different spacing from the projections of the corresponding channels and discontinued ribs of separator A, that is with reference to the example in connection with the projections 2 and 3a (3'a).

Otherwise, identical remains in the two separators the distribution of the projections 1 formed in the channels C_1, the provision of the continuous ribs N_1, N_2 defining such channels, the shape and size of all the projections and depressions.

Generally, for a plurality of separators intended to form a pack, there will vary the longitudinal spacings between projections of the channels and discontinued ribs between two channels C_1 of a separator with respect to the longitudinal spacings for the projections of the channels and discontinued ribs corresponding to any other separator.

Thus, in a pack of separators, due to the longitudinal and transverse shift of the projections, no protrusion of a separator can nest in the cavity of another separator with which it is in contact, with the result that, during the extraction of any separator from the pack, no jamming would occur and the separator can be readily extracted from the pack or unit.

This particular structural feature or design of the separators according to the invention, advantageously enables the use of automatic packing machines during the formation of the plate packs, just owing to the feature thereof of smooth sliding and resistance against the pressure under the thrust of the machine blade.

Figs. 4 and 5 clearly show the configuration taken by a plurality of superimposed separators A, B, C, ... C_{1p}, C_{2p}, C_{3p}, C_{4p} ... denote the lines of location respectively for the channels C_1, C_2, C_3, C_4 ... of the various separators, while N_{3p}, N_{4p}, N_{5p}, ... denote the lines

of location respectively for the ribs N_3, N_4, N_5 ... of the various separators.

It should be appreciated that the ribs of each separator bear on the projections of the underlying rib. Thus, for example, the ribs N_3, N_4 ... of separator B bear on the projections 3a, 4a ... of the ribs N_3, N_4 ... of separator A.

Similarly, the projections of the overlying channel bear on the flash of each channel. Thus, for example, the projections 3', 4' of channels C_3, C_4 of separator B bear on the flash or tunnel of channels C_3, C_4 of separator A (see Fig. 5).

This particular coupling of the separators just ensures the easy longitudinal extraction thereof from the pack, when required.

For providing the above described separators, any material can be used, provided that such a material has suitable characteristics of porosity, resistance to electrolyte attack, etc.

In any case, the separator shaping (design) is obtained by a drawing operation provided on a continuous web of material from a roll or a web forming system.

The web may be smooth or previously partly shaped and before being subjected to drawing operation, it may be in case heated, and after such an operation cut to size of the separator to be obtained.

Fig. 6 schematically shows a system for continuous manufacture of separators according to the invention, comprising thermoplastic materials.

Reference numeral 11 denotes a metal conveyor belt driven at constant speed by rollers 12, reference numeral 13 a thermoplastic powder, such as PVC, deposited by a hooper 14 on belt 11 and levelled to the desired thickness, and reference numeral 15 a hot air sintering furnace, in which the powder introduced by the belt is converted to thin sinterized porous sheet 16 as a continuous web.

Such a web may be wound up in bobbins or reels for formation at proper time or, as shown in the figure, to be immediately subjected to the drawing operation in the apparatus located at the outlet of furnace 15.

This apparatus comprises supports or bearings 17 for guide of web 16, before and after drawing at least one tension roller 18 located at the inlet, a heating device 19 for web heating before drawing, a pair of rollers 20, 21 for drawing operation, and finally a cutting device 22 for providing the sized separators from the drawn web.

Web heating by means of device 19 facilitates the next forming operation and also enables to increase the web sliding speed and as a result the production of the separators since the rollers 20, 21 have only to shape the web.

In said pair of rollers, roller 20, which is made of metal, is the forming roller and accordingly has a shape suitable to the separator to be obtained, while the other roller, which is smooth and made of rubber, is a pressing roller. One or both rollers are powered and roller 20 is thermo-adjustable.

In order to provide a drawn web from which obtain the separators according to the invention, the forming roller 20 comprises some pairs of circumferential grooves distributed in the direction of the roller width, separated by circumferential projections discontinued by depressions following one another at close spacing and constant pitch throughout the circumferential development of the roller, and also comprises between said pairs of grooves or sidewise thereto a plurality of circumferential projections separated by circumferential grooves, interrupted respectively by depressions and projections following one another throughout the circumferential development of the roller at a larger spacing than the close spaced apart depressions of the pairs of grooves.

Moreover, the depressions or respectively the projections of any projection or groove between or juxtaposed to two pairs of grooves follow one another at a different spacing to one another and with respect to the spacing of the depressions of any other projection or groove. In other terms, when following the pairs of grooves throughout the roller circumference there are no projections. Following the circumferential projections between two of said grooves, there are

depressions at a close spacing and constant pitch, which spacing is equal to or slightly larger than the center distance between the grooves of the pair.

Again, by following a circumferential projection between two pairs of grooves, there are depressions at a larger spacing than said center distance and different from one depression to another throughout the roller circumference.

The same is valid for any other projection.

Finally, by following a circumferential groove between two pairs of grooves, there are projections at a larger spacing than said center distance and different from one projection to another throughout the roller circumference.

The same is valid for any other groove.

After drawing step, the web 16' is cut to measure by the cutting device 22, the operation of which is timed with the web feeding speed.

Fig. 7 shows on enlarged scale the drawn web at the outlet of rollers 20, 21, that is prior to cutting.

Of course, said web is continuous or endless, but here only a length L thereof is considered, which length is assumed to be equal to the circumferential development of roller 20. This means that the web length 16' is the drawn web available at the roller outlet after a complete revolution of the forming roller 20.

Five separators in web 16' are indicated at I, II, III, IV and V, each of a length L_1, obtainable after cutting according to the dashed lines.

In said length of web 16', there are again the channels C_1, distributed transversely of the web, defined by the continuous ribs N_1, N_2 and the channels C_2, C_3, ..., and the ribs N_1, N_2, N_3, ..., between two channels C_1.

Said channels C_1 have therein the depressions 1' generating the projections 1 at close spacing and constant pitch, and in the channels C_2, C_3 there are the depressions 2' generating the projections 2, 3 at irregular and larger spacing than that of the projections 1.

The ribs N_3, N_4, ... are also shown, in which the projections 3a and 4a, ... are formed, also at irregular and larger spacing than that of projections 1. Thus, the projections are longitudinally and transversely shifted, so that the design of a separator cannot be repeated with respect to that of the other separators, which in a plurality of superimposed separators prevents any projection of one separator from engaging in the hollow of another separator and causing jamming of the separators during extraction from the pack.

It was assumed that the length L of the section of web 16' corresponds to the circumference of roller 20 and that such a circumference is a multiple of the length of separators I, II, III, ..., and particularly that L is five times L_1.

In such a case, after a revolution of roller 20, there is a repetition of the design of the section of web 16'. In order that the design repetitivy is delayed as much as possible and that the probability is removed that two identical separators of the web come in contact during the formation of a pack of separators, according to a further aspect of the invention, use can be made of a forming roller having a circumference of different length than a multiple of the length of a separator. Thus, in the example of Fig. 7, if L_1 = 12 cm, the circumference length of roller 20 will be larger or lower than a multiple of 12 cm, for example can be larger that (12 x 5) 60 cm.

The embodiment of the separator and production means above described are not restrictive at all. Thus, changes and modifications can be made to the foregoing without departing for this from the scope of the invention.

Thus, for example, the number of channels C_1 defined by two continuous ribs N_1, N_2 may vary depending on the separator width and material used. In a narrow separator, only one channel C_1 may suffice, as formed on the center line of the separator. At the central zone, also two channels C_1 could be provided, so that some channels with projections at irregular spacing would lie on the two outer sides of channels C_1.

Additionally, it is not necessary that the pitch of the projections in said channels C_1 is strictly constant. It is instead required that such projections are quite close to one another, as they should mainly ensure the spacing apart between the plates.

Again, in a separator some projections of the channels and discontinued ribs between two channels C_1 could follow one another at a same spacing. It is essential that a shift would exist with the corresponding projections of the separator intended to be superimposed thereto.

WHAT WE CLAIM IS:

1. A microporous separator for storage batteries, particularly starter batteries, of the type comprising a plurality of ribs and longitudinal channels, characterized in that the ribs (N_1, N_2, N_3 ...) are hollow and at a very close spacing from one another relative to those of conventional separators and have substantially a same thickness as that of the flash defining the channel, and that both the channels (C_1, C_2, ...) and the ribs or most of the latter (N_3, N_4, ...) respectively have on the two opposite sides of the separator hollow longitudinal projections (2, 3, 3a, 4a, ...) contributing to define the two bearing planes or faces of the separator and the distribution of which in a plurality of separators intended to be superimposed varies in sufficient degree from one separator to another, so that in a pack of separators no projection of a separator can nest in the cavity of the other separator and extraction of any separator according to the bearing plane or face can be readily carried out.

2. A microporous separator as claimed in Claim 1, characterized in that the spacing between the ribs is less than 12 mm, and preferably in the range of between 6 and 12 mm.

3. A microporous separator as claimed in Claims 1 and 2, characterized in that the longitudinal projections (1, 2, 3, ...) of the channels (C_1, C_2, C_3, ...) protrude from the side of the ribs, while the longitudinal projections (3a, 4a, ...) of the ribs as provided by depressions protrude from the opposite side, and that the projections (1) of one or some channels (C_1) distributed transversely of the separator follow one another at close spacing, while the projections (2, 3, ...) of the remaining channels (C_2, C_3, ...) and ribs (N_3, N_4, ...) interrupted by the depressions (3'a, 4'a, ...) follow one another at an irregular and larger spacing than that of the closely spaced apart projections (1), and that the projections at irregular spacing (2, 3a, ...) of the channels and discontinued ribs between two channels (C_1) with projections (1) closely spaced apart or juxtaposed to one or to such channels, are shifted transversely of one another and longitudinally to the projections of the corresponding

channels and discontimued ribs of a plurality of separators intended to be superimposed to one another.

4. A microporous separator as claimed in the preceding claims, characterized in that the channels (C_1) with closely spaced apart projections (1) are defined by contimuous ribs (N_1, N_2).

5. A microporous separator as claimed in any of the preceding claims, characterized in that the closely spaced apart projections (1) have a constant pitch.

6. A microporous separator as claimed in Claim 5, characterized in that the constant pitch of the closely spaced apart projections is substantially the same as the width of the channel in which they are formed, preferably slightly larger than said width.

7. A microporous separator as claimed in Claims 1 and 4, characterized in that the ribs terminate with a flat or rounded surface.

8. A microporous separator as claimed in Claims 1 and 6, characterized in that the projections formed in the channels are of tapered shape, preferably as a truncated pyramid, and that the base of such projections partly engages the channel width, so that the passage of electrolyte therethrough is assured by at least the side passages of the projections.

9. A microporous separator as claimed in Claims 1-3 and 7, characterized in that the projections (3a, 4a, ...) formed on the discontimued ribs (N_3, N_4, ...) are of convex shape and the depressions (3'a, 4'a, ...) of concave for the formation thereof are of such a depth that two adjoining channels are communicated.

10. A microporous separatcr as claimed in the preceding claims, characterized by being provided by drawing.

11. A process for contimuous production of microporous separators as claimed in the preceding claims, characterized by the steps of contimuously feeding of a material strip, in case heating the portion of strip to be drawn, strip drawing, and finally cutting the drawn strip to the size corresponding to that of the desired separator.

12. A process for contimuous production of separators as claimed in Claim 11, characterized in that said strip is contimuously fed

from a roll or from a strip forming system.

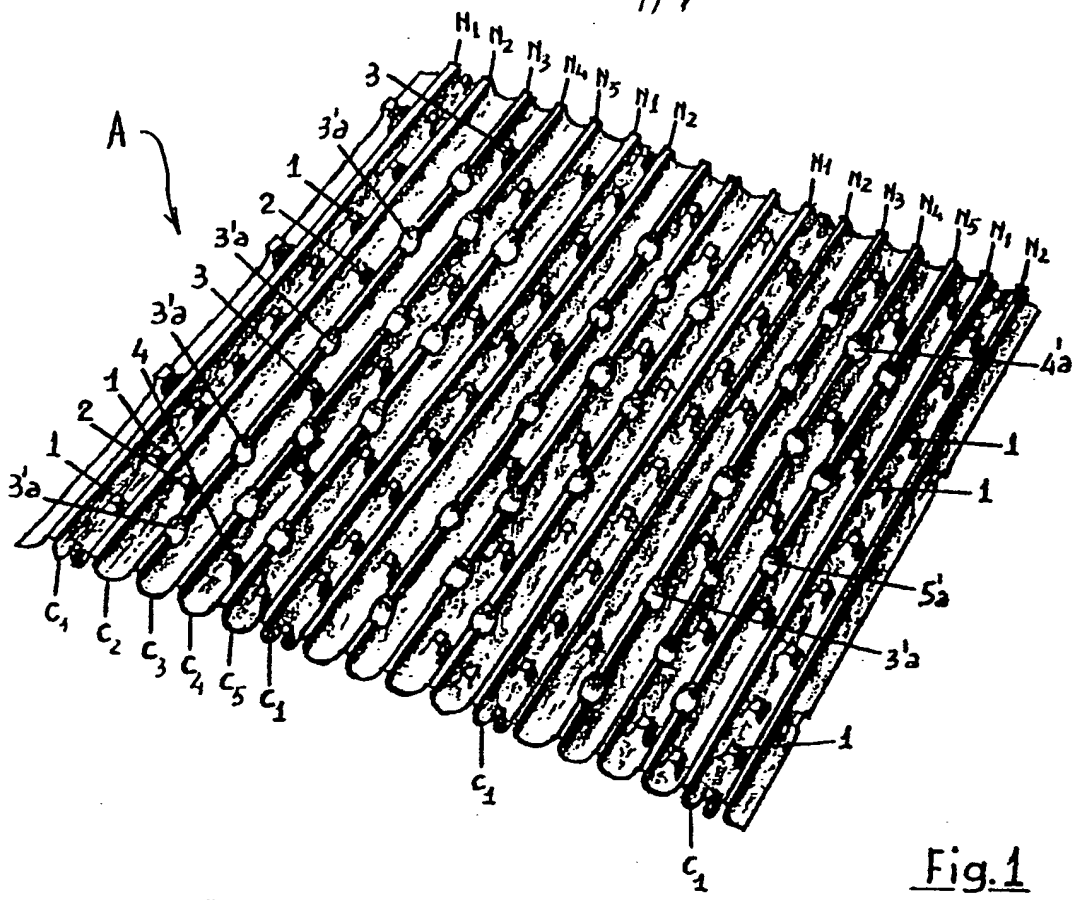
13. A process for continuous production of separators as claimed in Claim 11, wherein the separator is of thermoplastic material, characterized in that said strip is ribbed and smooth and is continuously fed from a sintering furnace of thermoplastic powders and is preheated prior to drawing operation.

14. A drawing apparatus for carrying out the process as claimed in Claims 11 to 13, characterized by comprising two rollers, of which one (20) is the strip forming roller and thermoadjustable, while the other (21) is a smooth resilient pressing roller (made of rubber).

15. A forming roller as claimed in Claim 14, characterized by having one or some pairs of continuous circumferential grooves, which are distributed transversely of the roller width and each separated by a circumferential projection discontinued by depressions following one another at close spacing and that, between or juxtaposed to said pairs of grooves, it also has juxtaposed circumferential grooves and projections respectively discontinued by projections and depressions following one another throughout the roller circumference at irregular and larger spacing than that of the depressions of the projection between the pairs of grooves, the whole according to the design of the separator to be obtained.

16. A forming roller as claimed in Claims 14 and 15, characterized in that the circumferential development thereof is preferably of a different length than a multiple of the length of the separator to be obtained.

17. Storage batteries, particularly starter batteries, incorporating microporous separators according to any of the preceding claims.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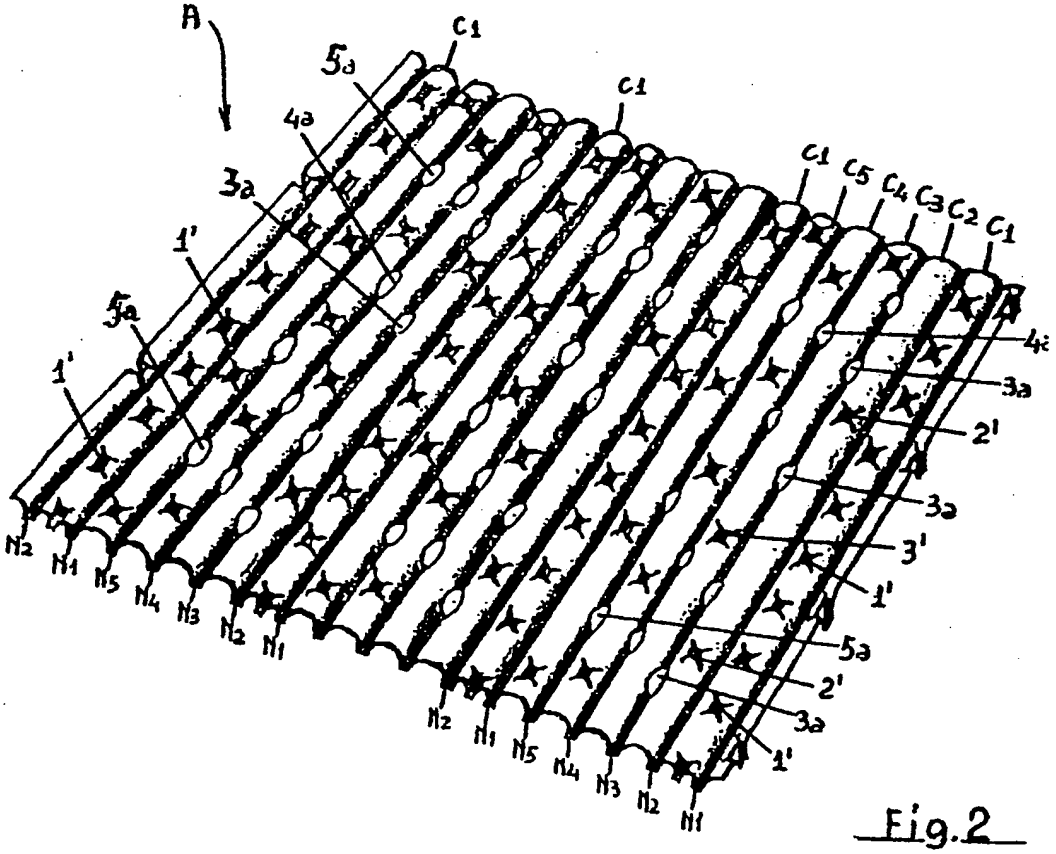
3
3'a
1
2
4
C1 C2 C3 C4 C5 C1

Fig.1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3a
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Fig.2

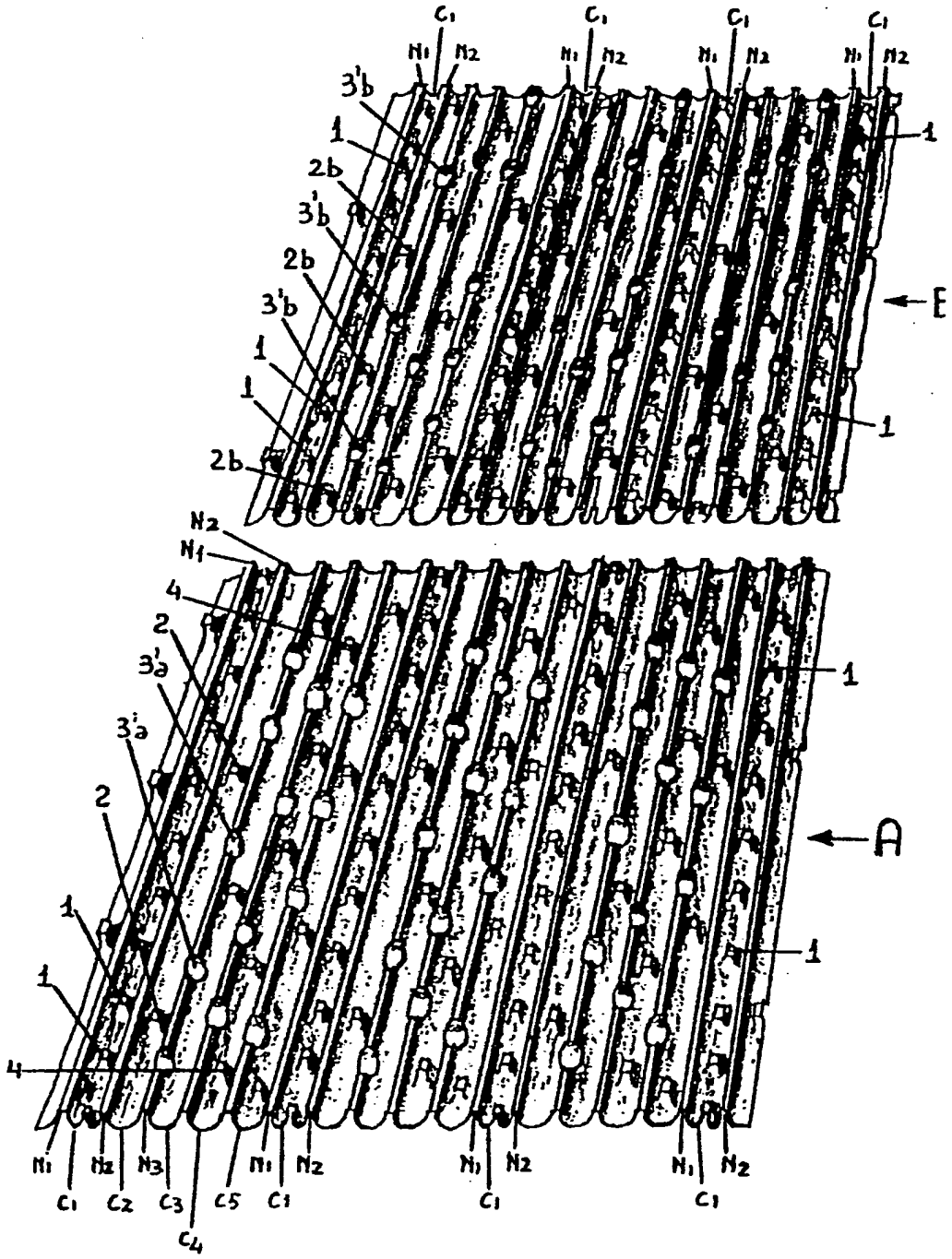
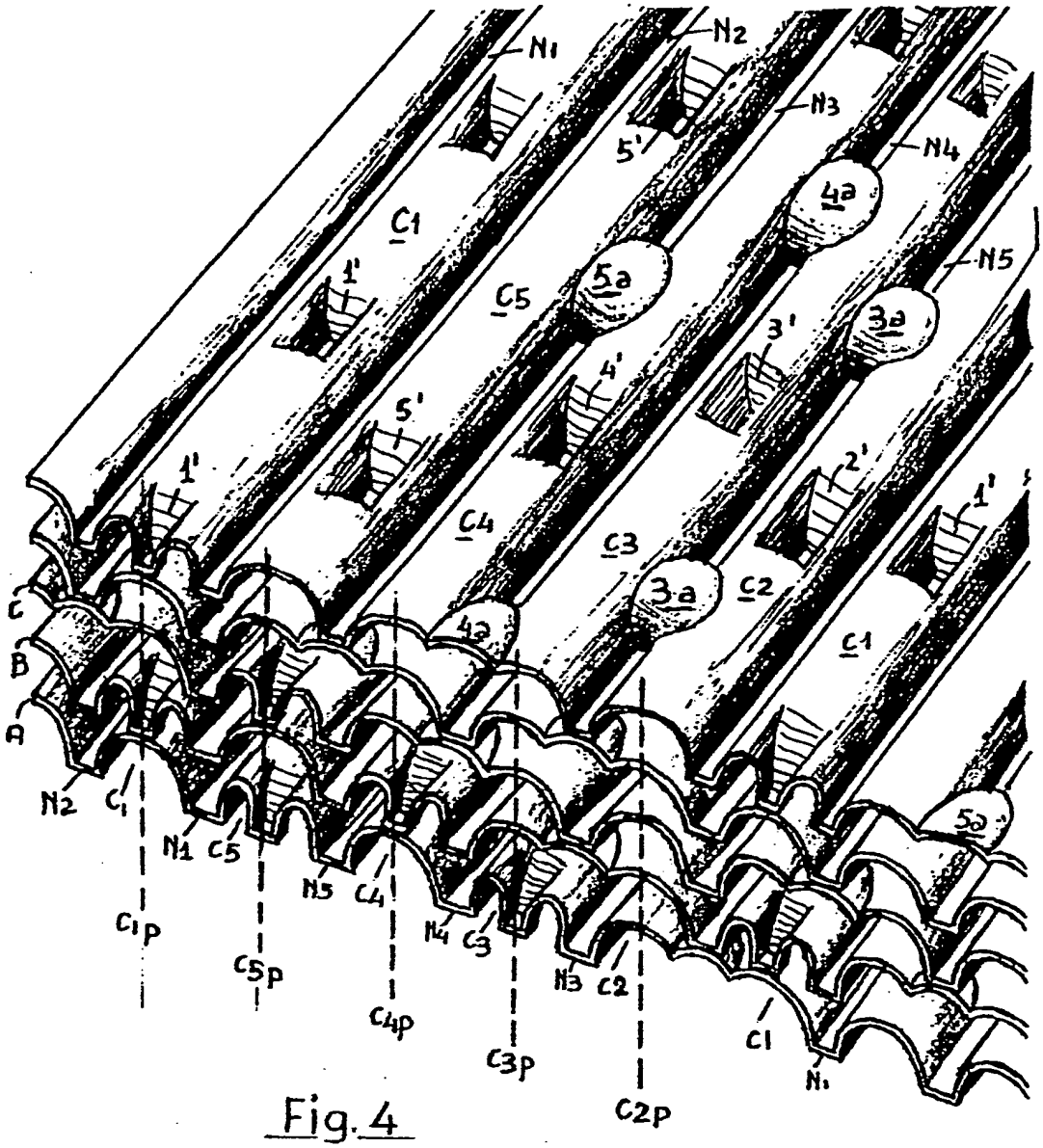


Fig. 3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N4
N5
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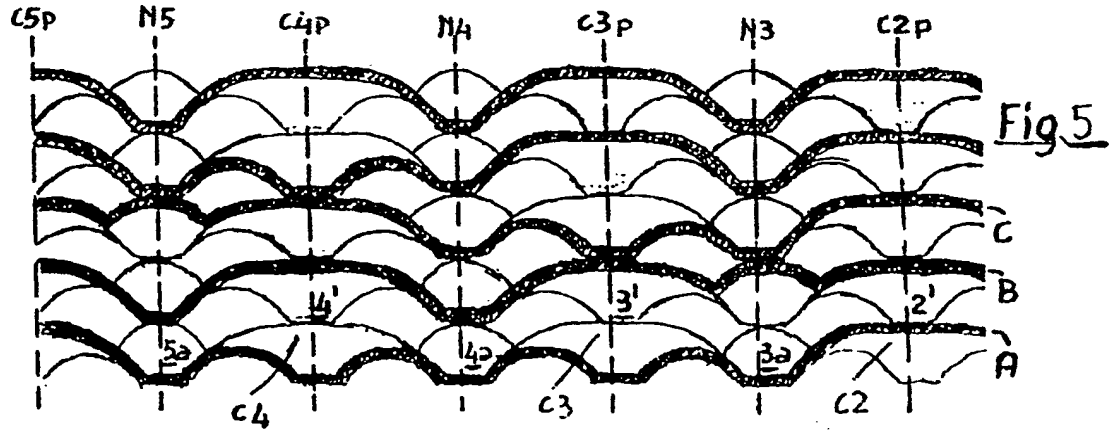
Fig. 4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C4
C3
C2

Fig 5

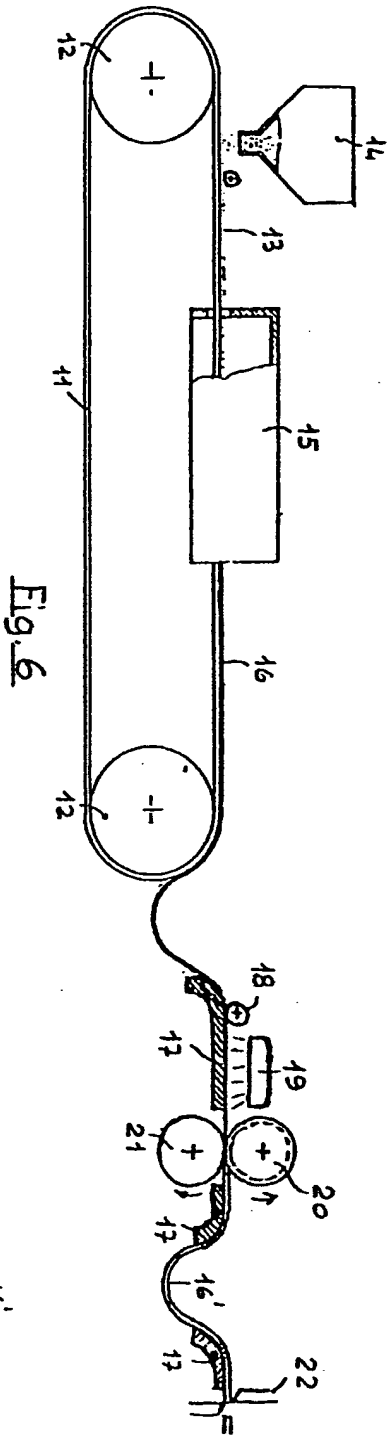

Fig.6

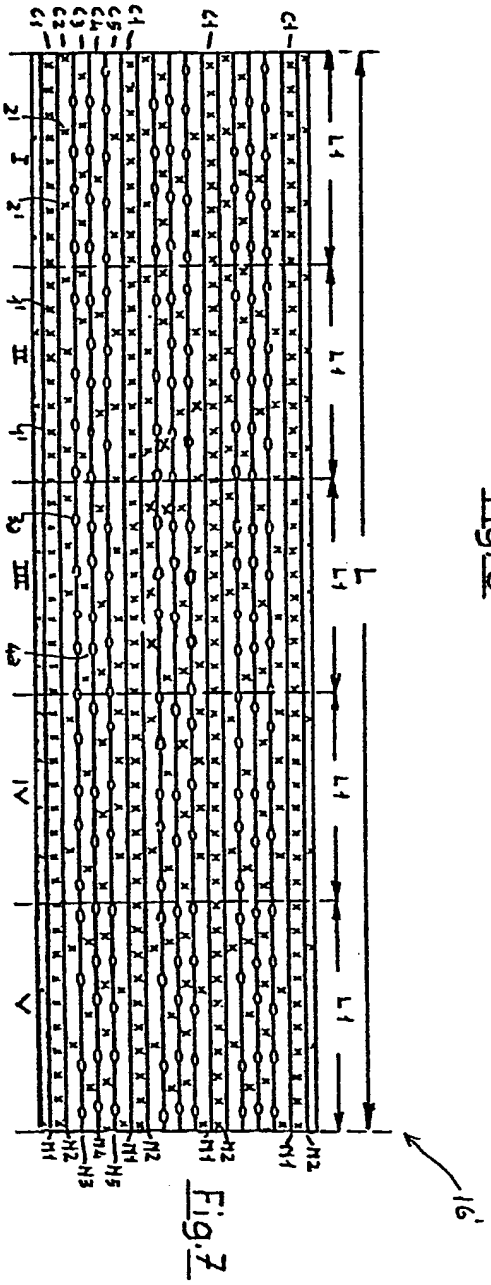

Fig.7

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EUROPEAN SEARCH REPORT

0121169
Application number

EP 84 10 2984

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl ³)
X	GB-A- 816 713 (L. JUNGFER) * Claims 1,2,6,7,8 *	11-13	H 01 M 2/18
X	WO-A-7 901 057 (TULLIS RUSSEL & CO.) * Figures 2,4; page 20, lines 19-30 *	11,12, 14	
X	US-A-3 329 559 (R.L. CORBIN et al.)	11-13	
A	US-A-2 694 744 (B. TAMBURINI)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
H 01 M 2/18
H 01 M 2/14

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13-07-1984	D'HONDT J.W.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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